

## ***Interactive comment on “Assessing high altitude glacier volume change and remaining thickness using cost-efficient scientific techniques: the case of Nevado Coropuna (Peru)” by P. Peduzzi et al.***

**P. Peduzzi**

pascal.peduzzi@grid.unep.ch

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Thank you for your high interest in our study. Here are some answers to your comments:

Question 1: How can the errors be reduced on the DEM methodology.

Answer: The methodology on subtracting of DEMs is a simple and effective one, alas the quality of DEMs is not of sufficient accuracy in mountainous areas (where we need them). The problem with ASTER DEM accuracy has been the subject of several publications (see <http://www.visionbib.com/bibliography/cartog947.html>). We thought that purchasing a DEM based on Radar imagery from a professional DEM producer would

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solve the issue: but even this was disappointing. The generation of DEM is still at early stage, but once this will be improve, this will provide substantial opportunities for computation of glacier volume losses.

Question 2: How many depth targets were acquired along the profiles? What was the typical spacing of the sampling locations? How many of the locations yielded high quality basal returns?

Answer: The Record parameters are provided in table 2:

Comment on 837-3: DEM's provide surface elevations and through differencing, volume change, not ice thickness.

Answer: Thank you, this error obviously escaped our attention and apparently the one of the reviewers too: I will inquire if we can change this in the text.

Question on line: 837-29: Why does pixel subtraction lead to such poor results, is it due to horizontal geolocation issues? Any reference besides Racoviteanu et al., (2007) on this topic?

Answer: In mountainous area, an horizontal difference of three pixels (90 m) can result in a very significant vertical difference, to the extreme that you can have a cliff of several hundreds of meters. This is why we strongly recommend to use the difference of the sum of all altitude. Regarding the literature, at the time when we did this (2004), I didn't find any article of such use of DEM.

Comment on Figure 1: Are the GPS coordinates shown for the ice thickness and GPS profiles? If so use a key to distinguish the various profiles, the points already have different colors.

Answer: yes the different colours represent the different profile.

Comments on Figure 3: More discussion of this figure would be appropriate. A second figure along another profile away from the crater, possibly at lower elevation and on a

steeper slope would be instructive. This would further illustrate the value and accuracy of the ice thickness measurements.

Answer: well, yes, I guess we can always do more.

Comment on Figure 5: What is the x-axis, what profile or transect is this? The fit is very good, again a second profile in a different setting would be useful (...) A basic statistic on the correlation between measured and modeled ice thickness is needed.

Answer: The x-axis is the time of record. This does not translate in distance as our walking speed changes, but we could have place there the minutes for clarity. The fit is indeed pretty good, the values of correlation between modelled and measured are provided on table 3. Except for lower altitude (5940 - 5980m) all the other values have pearson between: 0.77 and 0.93. So this profile is very representative of the collection of sample.

Comment on Figure 7: Where along these transects are control points where the ice thickness was measured, mark with a dot or an x in the figure.

Answer: There would be very few given that transect are strait lines and collection where our itinerary following many curves.

Comment on Figure 8: Why the 1955-1997 comparison instead of 1955-2002?

Answer: because the DEM 1997 was produced by a professional firm (SARMAP, Switzerland) based on ESA/SAR radar imagery. The radar DEM was much more reliable as compared with the ASTER DEM (2002). The illustration has a double purpose, it shows the result of the DEM analysis but also highlight the problem of no data (typical from radar signal on some surface or shadow by relief), even when using professional DEM. In ASTER DEM you don't get the no data issue, but you have much more distortion, this effect is much less visual.

Thank you for your valid comments and interest in this subject. Pascal Peduzzi

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Interactive comment on The Cryosphere Discuss., 3, 831, 2009.

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